

**Long Term Performance Data for Horizontal  
SVE System to Mitigate Elevated Indoor Air  
VOCs and High Strength Sub-Slab VOCs at  
Active Military Building  
Naval Air Station North Island,  
San Diego, CA**

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# Project Team



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# Presentation Overview



- 1. Introduction**
- 2. Objective**
- 3. Remedial Activities**
- 4. SVE Results**
- 5. Approach**
- 6. Findings**
- 7. Results/Lessons Learned**

- A vapor intrusion sampling program was initiated at NAS North Island in 2014
- cVOC levels in the sub-slab soil gas sampling were found to be  $>10,000,000 \mu\text{g}/\text{m}^3$  at Building 379, theoretical calculations suggested an indoor issue, and the follow-on indoor air investigation found TCE exceeding acceptable levels
- A Time Critical Removal Action was initiated in 2015:
  - Sealing of over 15,000 linear feet of cracks/joints
  - Implementation of a VI mitigation system consisting of SVE, steam injection and LNAPL recovery

## Objective – Evaluate Long-term Performance & Operation Optimization

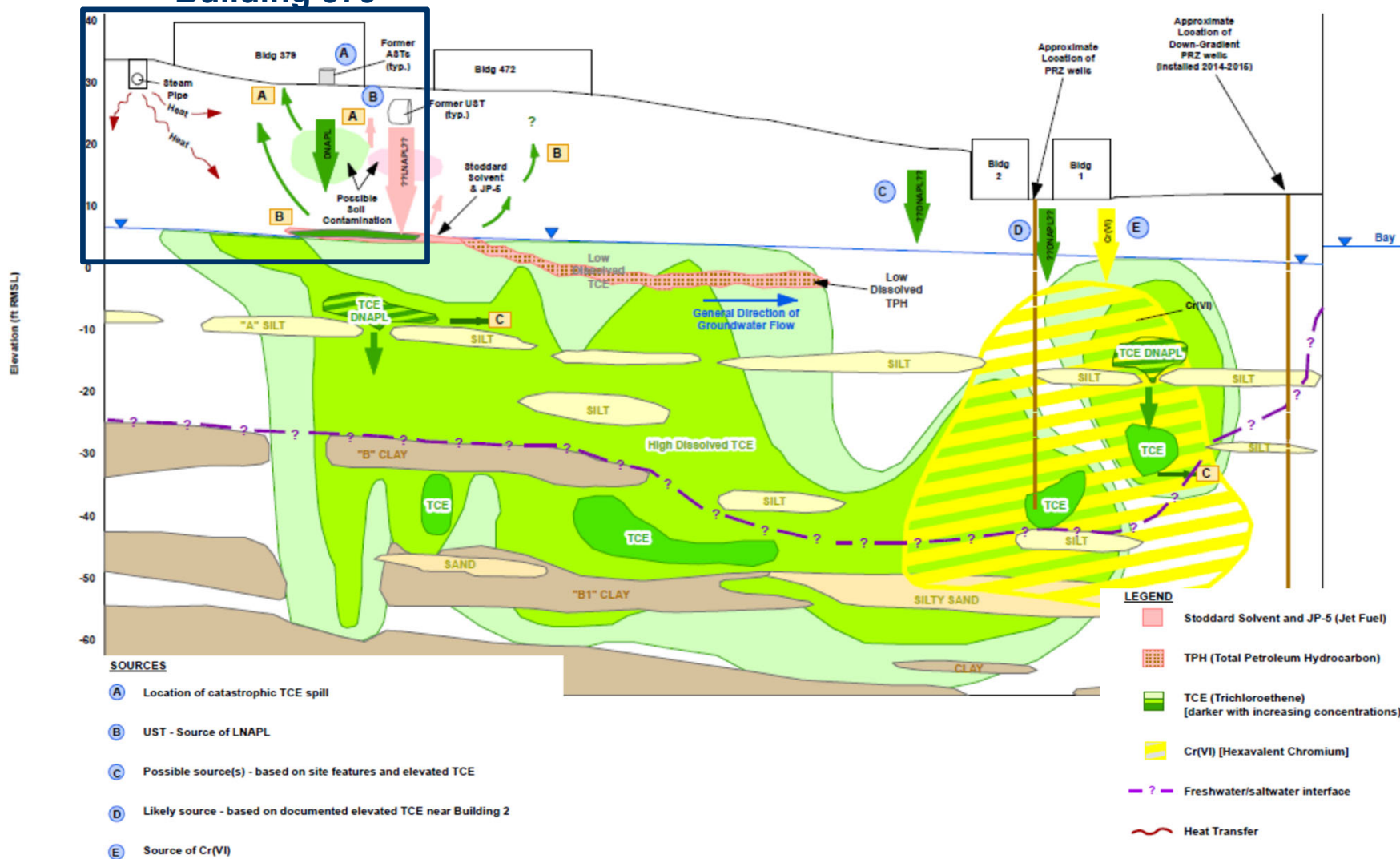


- Evaluate long term performance of the crack/joint sealing and SVE in mitigating the VI, primarily in terms of:
  - Levels of cVOCs in sub-slab soil gas
  - Levels of cVOCs in indoor air
- Given that the SVE system is occasionally off (power outages, system maintenance):
  - How long can the SVE system be off before there is an exceedance in indoor air?
  - Can the system be operated in a cyclical mode to reduce utility costs?
- Will mass removal significantly reduce the active remediation timeframe?

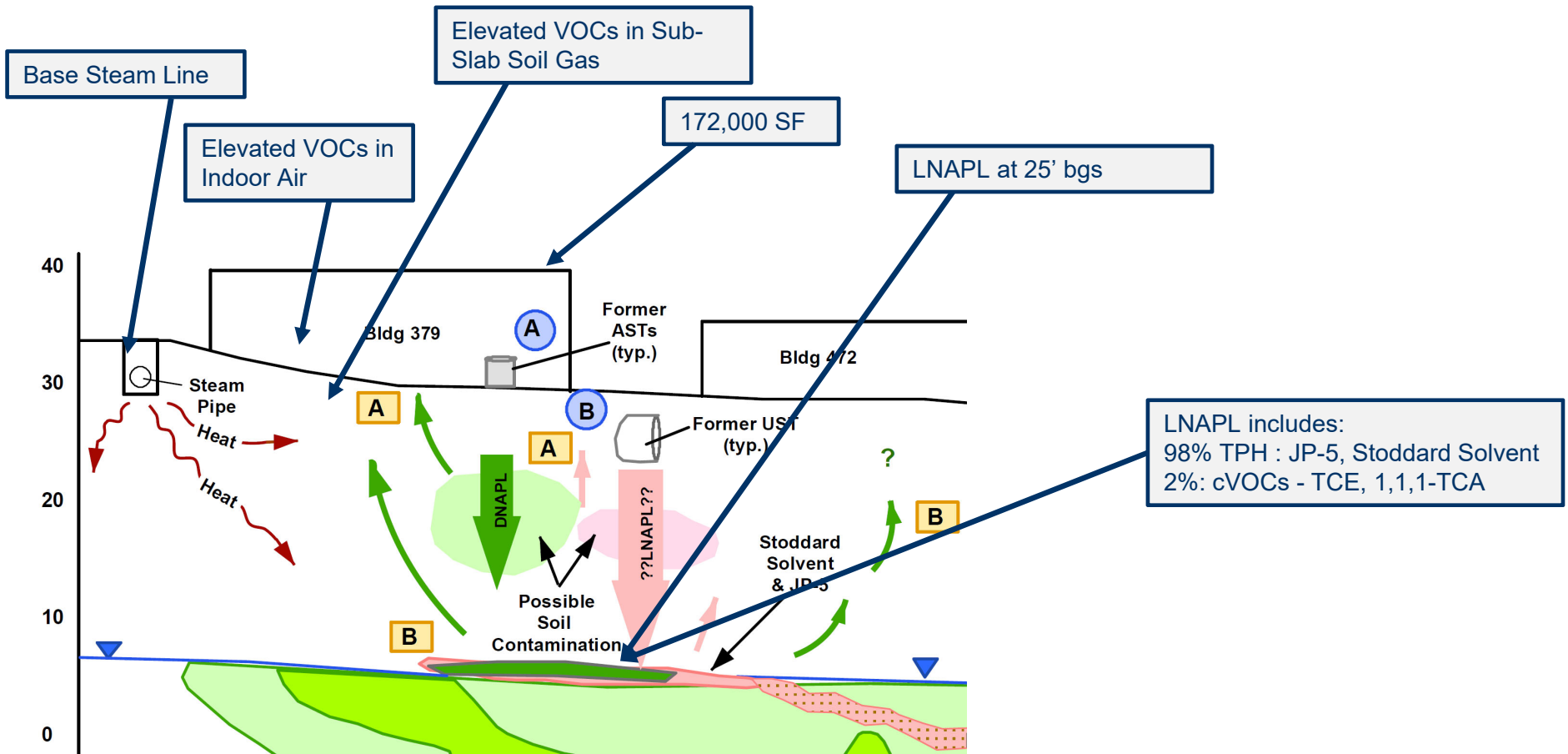
# Background – Operable Unit 20 - Building 379



## Building 379



# Background – Building 379 Conceptual Site Model



## Background - Pre-TCRA Site Conditions (2015)



- LNAPL volume estimates - range from tens to hundreds of thousands of gallons, >98% TPH and <2% cVOCs
- Approximately 40% of the LNAPL footprint includes cVOCs
- A portion of the LNAPL plume was at temperatures above 100 °F, due to Base steam line (the steam line was deactivated in 2018)
- Elevated levels of cVOCs in sub-slab soil gas (over 10,000,000  $\mu\text{g}/\text{m}^3$ ) and in indoor air [above indoor air screening levels (IASLs)]
- cVOCs represent approximately 50% of the soil vapor concentrations (although < 2% of LNAPL is cVOCs)



## Background - Building 379 VI TCRA



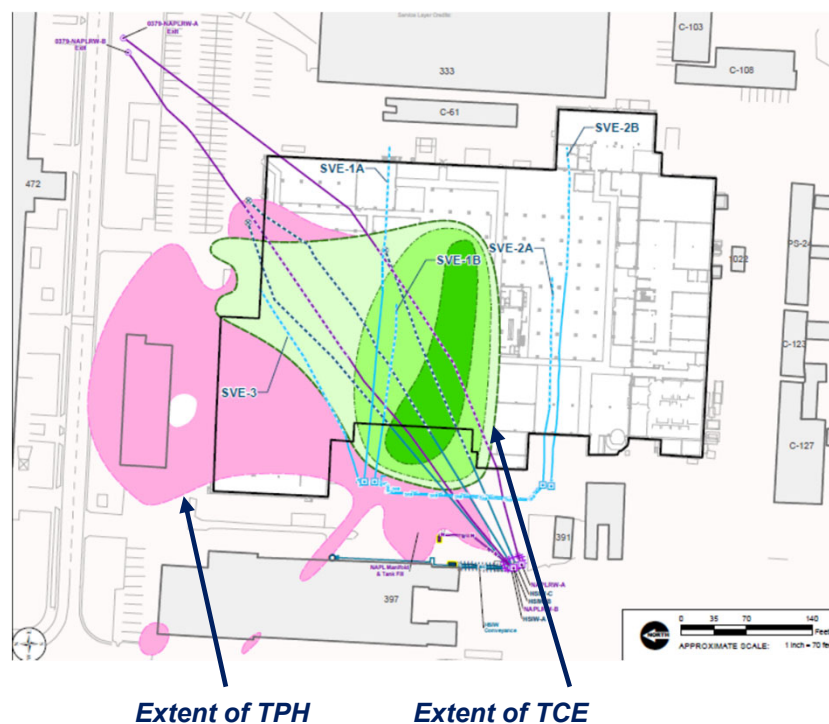
The VI TCRA included the following:

- Offered relocation to sensitive receptors, modified operation of the ventilation system
- Sealed over 15,000 LF of cracks and joints
- Sealed pathways in both restrooms, floor in lunch room received seal coat
- Deployed Air Purification Units in selected rooms
- Installed dual-screened horizontal SVE well under Building 379
- Extraction started on May 18, 2016
- System enhancements constructed in 2017:
  - 3 new horizontal SVE wells
  - 3 Steam injection wells
  - 2 LNAPL Recovery wells

# TCRA SVE Components



- An SVE system has been in operation since May 2016, implemented as a mitigation measure for sub-slab and indoor air VOC concentrations.
- The system consists of:
  - Two horizontal SVE wells installed in 2016 under the northern portion of the building at 10 feet bgs
  - Three additional horizontal SVE wells, 3 Steam Injection Wells, and 2 LNAPL Recovery Wells installed in 2017



# SVE Results: Sub-Slab Vacuum Responses

Results in Pascals (Pa)



September 2016 – SVE-1A and 1B

February 2017– Only SVE-1B



***The large ROI (>100 feet) is likely enhanced by the sealing of the cracks and joints.***

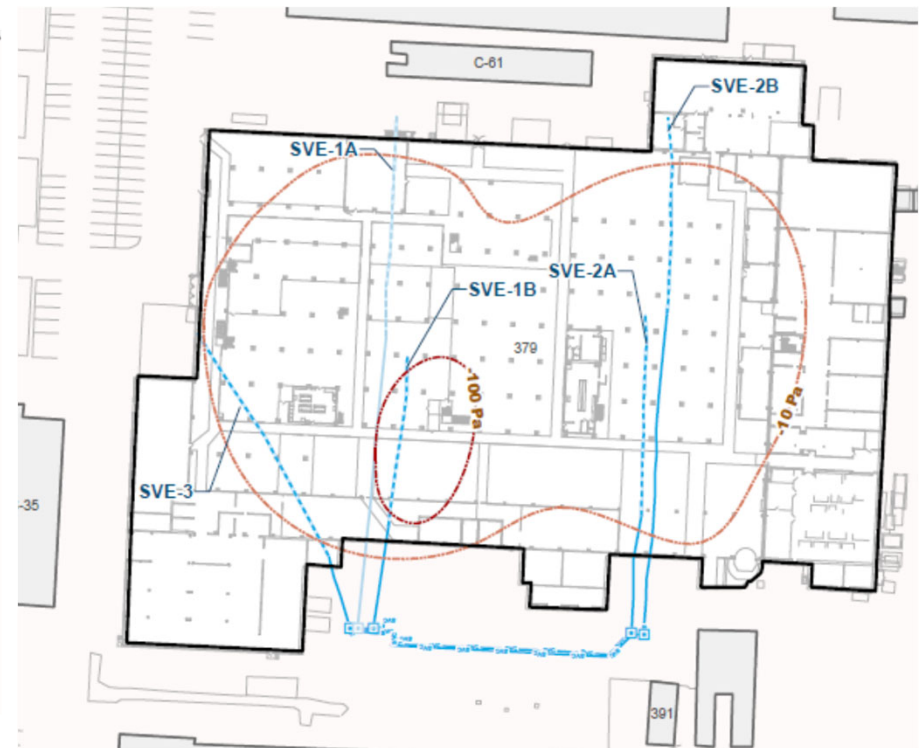
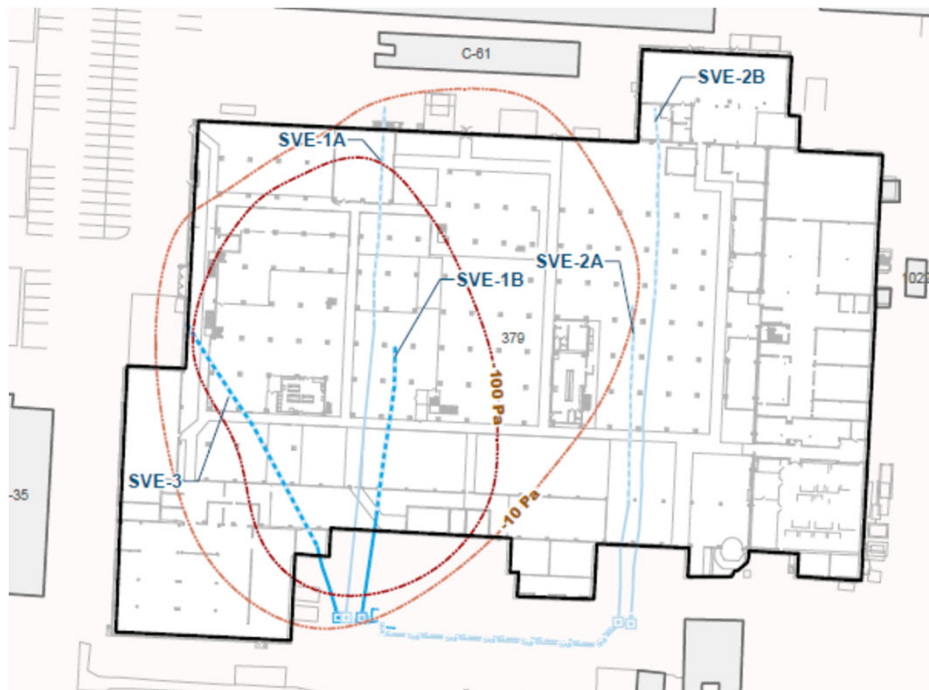
# SVE Results: Sub-Slab Vacuum Responses

Results in Pascals (Pa)



February 2018 – SVE-1B and SVE-3

August 2018 – SVE-1B, SVE-2A,B, SVE-3

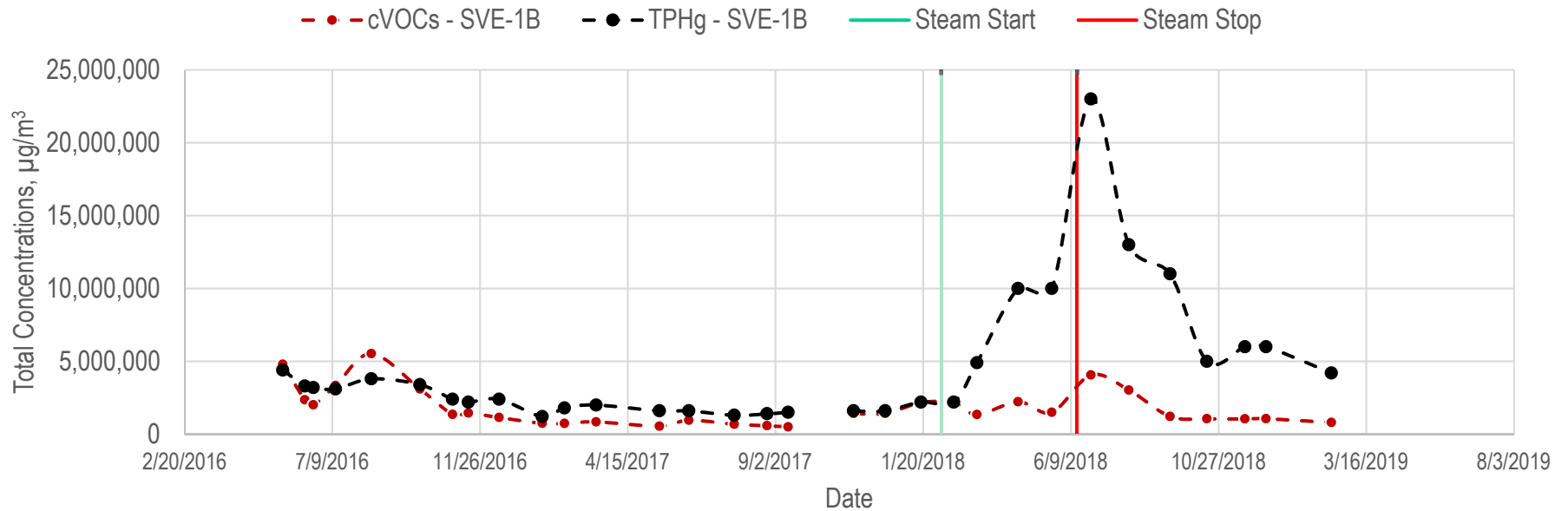


**Most of the Building is under vacuum**

# SVE Results: Extraction Metrics

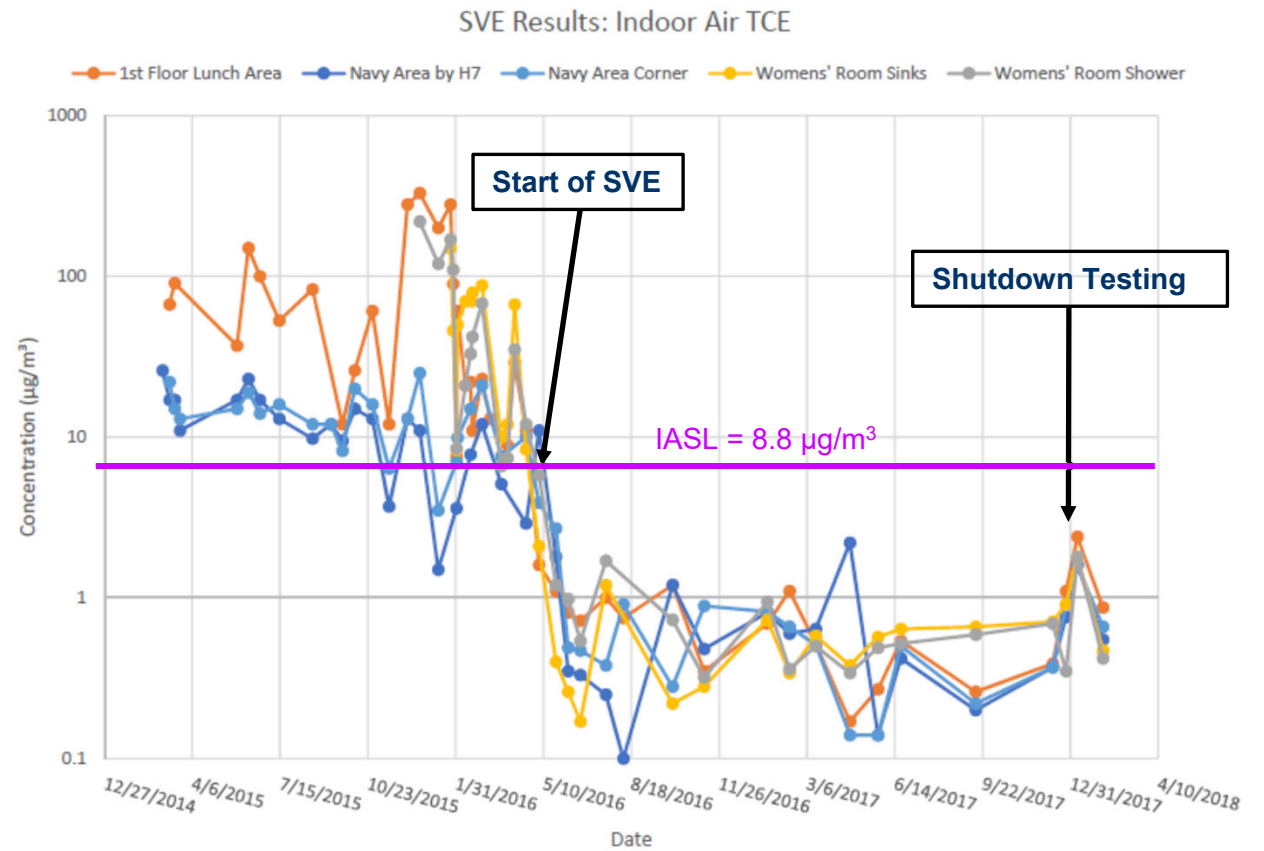


### Total cVOCs and TPH in SVE 1B Influent ( $\mu\text{g}/\text{m}^3$ )

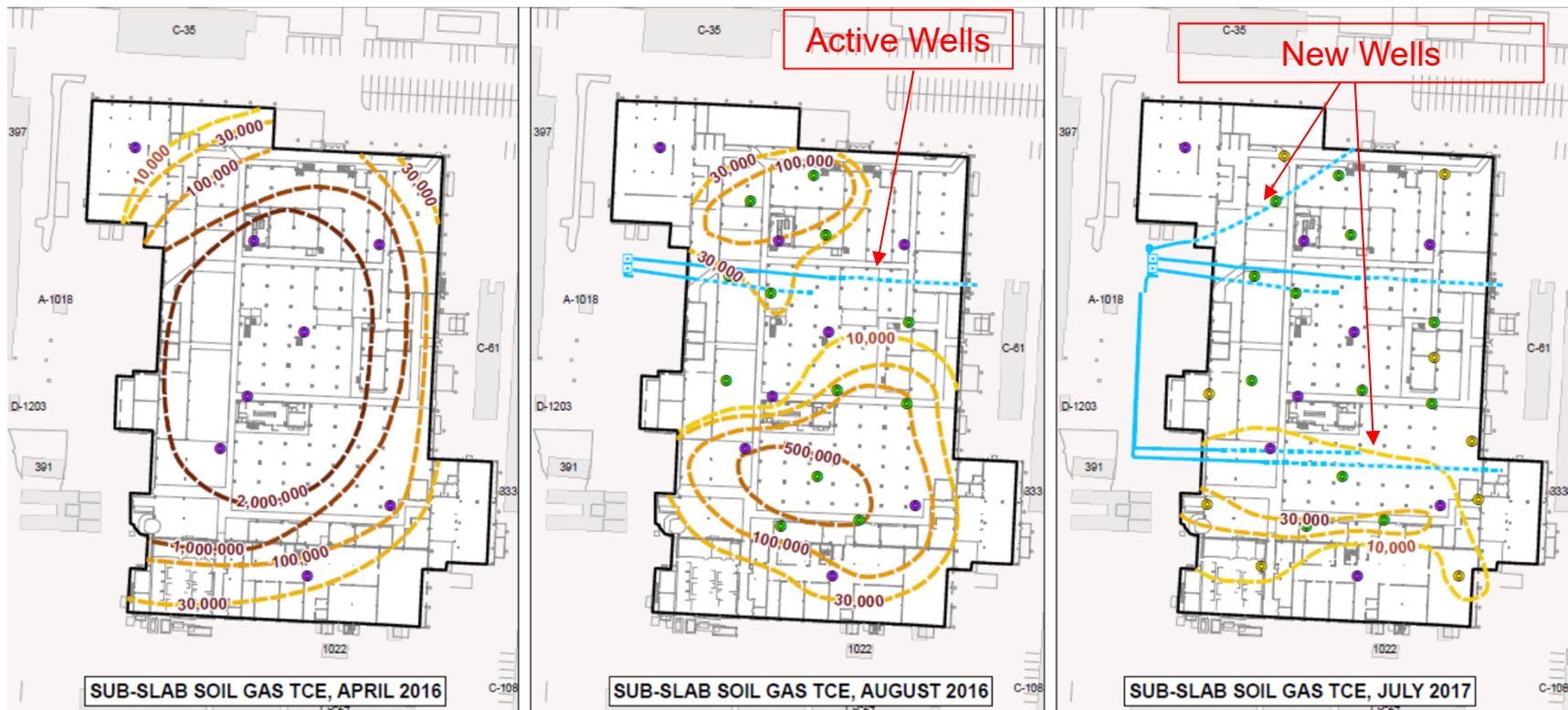


- >6,300 gallons of TPH/cVOCs have been recovered and recycled by the SVE system
- Levels of cVOCs and TPH in extracted vapor have decreased significantly (but still above 1,000,000  $\mu\text{g}/\text{m}^3$ )

# SVE Results: Indoor Air TCE



# SVE Results: Sub-Slab Soil Gas TCE



- TCE footprint decreased after 15 months of operation of 2 wells (SVE-1A & 1B)
- Samples were collected under “dynamic” conditions, i.e., SVE wells were extracting

## SVE Results: TCE in Indoor Air



- 49 events of indoor air sampling have been completed since 2016
- **No exceedance of IASL for TCE after SVE operations started in May 2016**
- Levels of TCE in indoor air in the Lunch Room and Women's Restrooms were above IASLs prior to SVE
- These decreased significantly after the SVE was initiated – the highest TCE was 2.4 and 1.8  $\mu\text{g}/\text{m}^3$  at these locations



## Cyclical SVE Testing



- The SVE system was shut down for approximately 5 weeks in late 2017/early 2018
- Levels of VOCs and fixed gases were measured in sub-slab soil gas at multiple locations and multiple depths using field instruments
- Indoor air VOCs were measured using Summas
- Developed simple predictive models to predict the time period that the SVE system could be off before:
  - Indoor air TCE exceeds IASL
  - Sub-slab soil gas TCE increases to a level that theoretically could cause indoor air TCE to exceed IASL

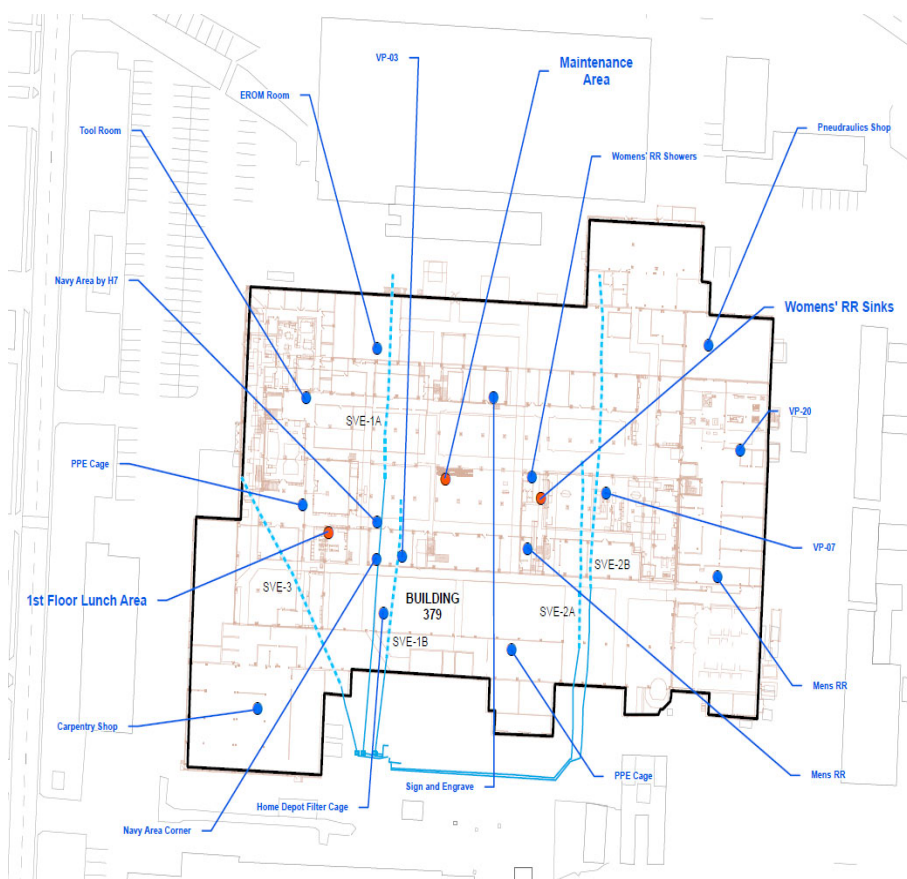
### Explanation of Theoretical Threshold

- IASL is  $8.8 \mu\text{g}/\text{m}^3$
- A building specific attenuation factor (BSAF) of less than 0.00001 was calculated for Building 379 (indoor air to sub-slab soil gas) using collocated samples
- To be conservative, a BSAF of 0.0001 was used
- Sub-slab soil gas TCE would need to reach 88,000  $\mu\text{g}/\text{m}^3$  before there is a potential for indoor air to reach  $8.8 \mu\text{g}/\text{m}^3$

# TCE Trends in Indoor Air



TCE in indoor air samples did not increase above IASL of  $8.8 \mu\text{g}/\text{m}^3$  after 5 weeks



SVE Results: Indoor Air TCE



# TCE in Sub-Slab Soil Gas – Overall Trends

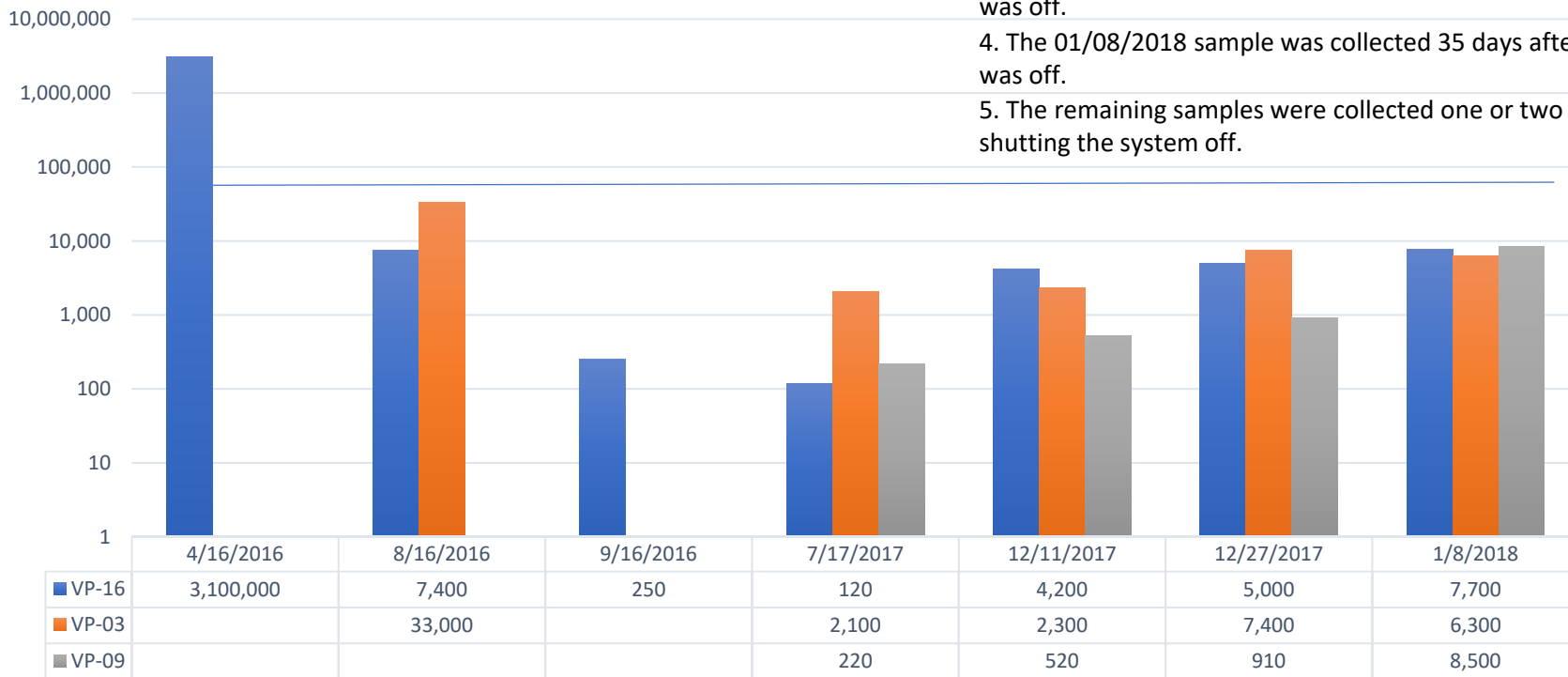


- TCE in sub-slab soil gas decreased by orders of magnitude after SVE was started
- A slight increase was observed during the 5 week shutdown, but remained below the theoretical threshold\* of 88,000  $\mu\text{g}/\text{m}^3$

Note:

- 04/16/2016 sample is pre-SVE.
- The 12/11/2017 sample was collected 7 days after the SVE was off.
- The 12/27/2018 sample was collected 23 days after the SVE was off.
- The 01/08/2018 sample was collected 35 days after the SVE was off.
- The remaining samples were collected one or two days after shutting the system off.

VPs (TCE)



■ VP-16 ■ VP-03 ■ VP-09

# Predictive Model – Indoor Air TCE



- Selected 3 locations (out of 20) with highest TCE levels and showed a distinct increasing trend
- Extrapolated to determine number of days to reach IASL of  $8.8 \mu\text{g}/\text{m}^3$
- Most conservative estimate is approximately 69 days

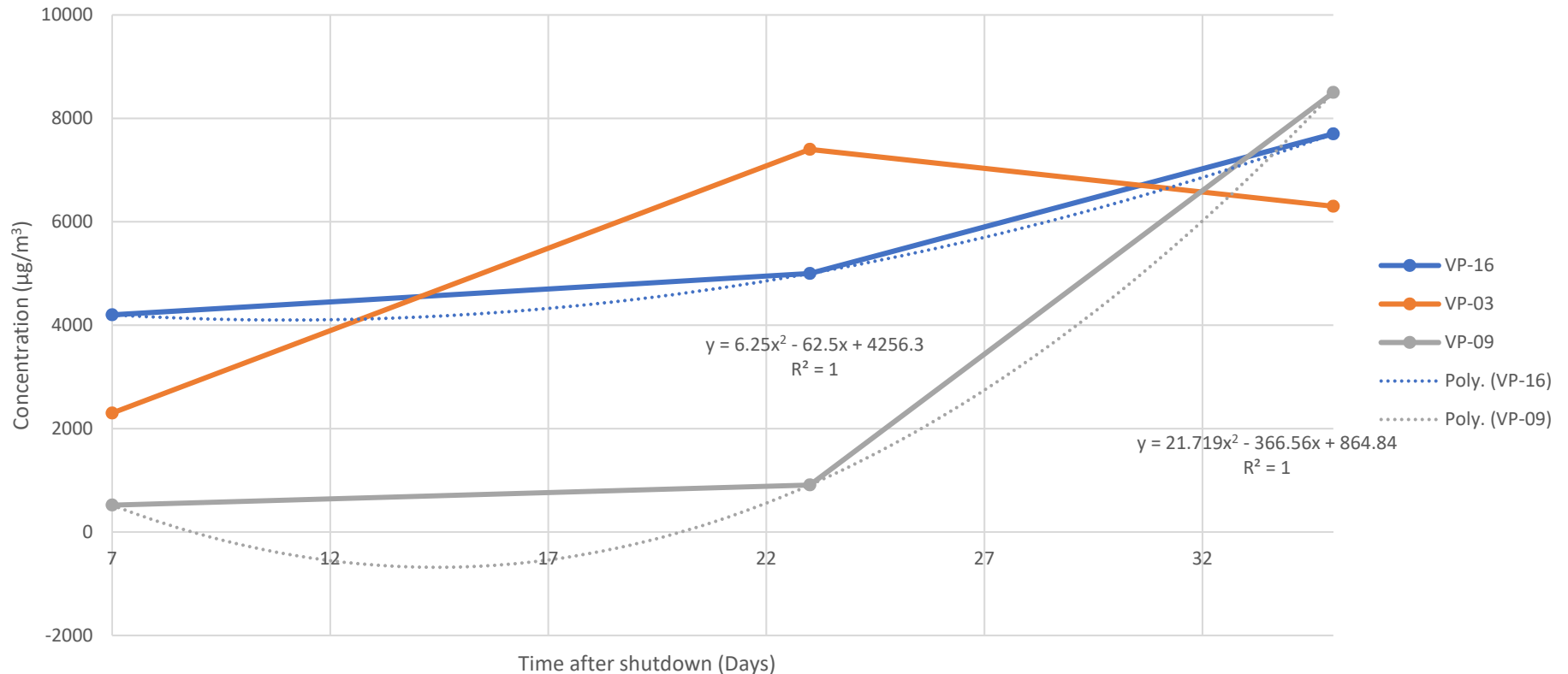


# Predictive Model – Sub-Slab Soil Gas TCE



- Selected 3 locations (out of 6) with highest TCE levels that showed a distinct increasing trend
- Extrapolated to determine number of days to reach threshold of 88,000  $\mu\text{g}/\text{m}^3$
- Most conservative estimate is approximately 72 days

SVE Results: Sub-Slab Soil Gas TCE



## Implications of Shut-Down Testing



- The system can be off for at least 5 weeks before there is an exceedance
- As noted previously, sub-slab soil gas is currently being measured under dynamic conditions, i.e., the SVE wells are extracting
- Static samples would provide a better indication of SVE performance – the trends in sub-slab soil gas indicate that collecting samples about 5 weeks after shut-down would provide a conservative estimate of sub-slab soil gas levels

## Summary of Results/Lessons Learned



- Operation of the SVE system has decreased sub-slab soil gas TCE levels by several orders of magnitude after 3 years of operation
- Operation of the SVE System has kept TCE in indoor air below IASL for 3 years
- The SVE system can (theoretically) be shut down for 2 months before indoor air TCE exceeds IASLs or sub-slab soil gas TCE reaches (theoretical) levels such that indoor air TCE would exceed IASLs – this would allow for cyclical operation, resulting in lower operating costs

**QUESTIONS?**